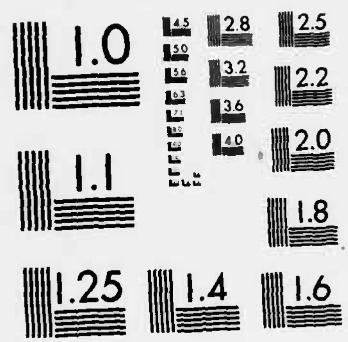
AD-A134 945 INFORMATION REQUIREMENTS FOR THE VIMS (VEHICLE INTEGRATED MANAGEMENT SYSTEM)(U) AIR FORCE INST OF TECH WRIGHT-PATTERSON AFB OH SCHOOL OF SYSTEMS AND LOGISTICS E T FOX SEP 83 AFIT-LSSR-72-83 1/1

UNCLASSIFIED F/G 5/1 NL

END



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

INFORMATION REQUIREMENTS FOR
THE VIMS

Edward T. Fox, Captain, USAF

LSSR 72-83

DEPARTMENT OF THE AIR FORCE
AIR UNIVERSITY
AIR FORCE INSTITUTE OF TECHNOLOGY

Wright-Patterson Air Force Base, Ohio

INFORMATION REQUIREMENTS FOR
THE VIMS

Edward T. Fox, Captain, USAF

LSSR 72-83

The contents of the document are technically accurate, and no sensitive items, detrimental ideas, or deleterious information are contained therein. Furthermore, the views expressed in the document are those of the author(s) and do not necessarily reflect the views of the School of Systems and Logistics, the Air University, the Air Training Command, the United States Air Force, or the Department of Defense.

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER LSSR 72-83	2. GOVT ACCESSION NO. AD-A134945	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) INFORMATION REQUIREMENTS FOR THE VIMS		5. TYPE OF REPORT & PERIOD COVERED Master's Thesis
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Edward T. Fox, Captain, USAF		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS School of Systems and Logistics Air Force Institute of Technology, WPAFB OH		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS Department of Communication AFIT/LSH, WPAFB OH 45433		12. REPORT DATE September 1983
		13. NUMBER OF PAGES 85
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15. SECURITY CLASS. (of this report) UNCLASSIFIED
		15a. DECLASSIFICATION DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

Approved for public release: IAW AFR 190-17.

Lynn Wolaver

LYNN E. WOLAVER
Dean for Research and Professional Development
Air Force Institute of Technology (ATC)
Wright-Patterson AFB OH 45433

15 SEP 1983

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Structured Interviews
Vehicle Integrated Management System (VIMS)
Information Requirements
Information Analysis
Decision Support Systems

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Thesis Chairman: James W. Annesser, Lieutenant Colonel, USAF

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

The Vehicle Integrated Management System (VIMS) processes data inputs and puts out reports to be used by Air Force vehicle fleet managers. The system was designed to give managers information to support their decisions. The problem centers around the fact that the VIMS has not been reevaluated since 1975. In the last eight years there have been changes in the information requirements of decision makers. In addition, there have been technological advances that have been made in the science of information gathering, processing, and reporting. This thesis examines the VIMS in the light of these changes and suggests modifications to bridge the gap between the VIMS outputs and decision makers' information requirements. A five-step process was used involving structured interviews of decision makers and surveys of VIMS outputs and Air Force regulations. Presented in this effort are the shortfalls of the VIMS and the recommended corrective actions.

LSSR 72-83

INFORMATION REQUIREMENTS FOR THE VIMS

A Thesis

Presented to the Faculty of the School of Systems and Logistics

of the Air Force Institute of Technology

Air University

In Partial Fulfillment of the Requirements for the

Degree of Master of Science in Logistics Management

By

Edward T. Fox, BA
Captain, USAF

September 1983

Approved for public release;
distribution unlimited

This thesis, written by

Captain Edward T. Fox

has been accepted by the undersigned on behalf of the faculty of the School of Systems and Logistics in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE IN LOGISTICS MANAGEMENT

DATE: 28 September 1983

COMMITTEE CHAIRMAN

ACKNOWLEDGEMENTS

I thank God for His love and guidance through it all. I thank my advisor, Lt Col James W. Annesser, who helped and inspired me. I extend my appreciation to Maj Ronald H. Rasch for his keen insight and knowledge. I give heartfelt gratitude to my typist, Mrs. Phyllis Reynolds, who stuck by me and pushed me forward. Finally, I extend a special thanks to my wife, Sylvia, who made it all come together with patience, understanding, and love.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

Overview

Vehicles are vital to the operation of an Air Force Base. The Air Force has over 100,000 vehicles in its inventory (12:4). Without the timely maintenance and replacement of these vehicles the readiness capability of the Air Force would be seriously degraded.

The Mission of the Air Force is to "fly and fight"; to do this the Air Force must generate and launch aircraft to defend U.S. interests worldwide. Air Force units use vehicles to get men, equipment, and aircraft to the appointed places at the appointed times. Delays due to vehicle failures could impose intolerable constraints or limitations on defense operations. This would ultimately jeopardize the safety of U.S. world interests. Managing vehicles for readiness involves keeping vehicles in a safe and operable condition to meet mission requirements.

Money for vehicle purchases, operation, and maintenance is limited. More effective management of vehicle maintenance, operation, and replacement will equate, indirectly perhaps--but certainly nevertheless--to increased readiness per dollar invested. This includes the management

of scarce petroleum resources. To be effective, managers must have adequate information. The Vehicle Integrated Management System (VIMS) is the primary system vehicle fleet managers use to process and report vehicle data/ information used in managing and maintaining the Air Force vehicle fleet.

This thesis will reexamine the information requirements of decision makers currently using the VIMS to aid their effective management of the vehicle fleet. By reexamining the VIMS, it can determine to what extent the system of vehicle fleet management has evolved beyond the service the VIMS now provides.

Problem Statement

For an information system to be an effective decision support tool, it must provide decision makers with the essential information with which to make decisions. Even after a system has been built and implemented, it should undergo reexamination periodically to ensure that the system is providing the necessary outputs to support decision making. The VIMS was last reevaluated in 1975. Given the technological advances in information gathering, processing, and reporting, the VIMS should be reexamined to determine if it provides all of the necessary information elements managers need to make vehicle fleet management

decisions. If the VIMS has information shortfalls, this thesis will identify those shortfalls and recommend corrective action.

Justification

An effective vehicle decision support system contributes to Air Force readiness capability and to the effective and efficient use of vehicle fleet resources. Improvements in this area can effect more timely scheduling of maintenance for vehicles and enhance the quantity and quality of information managers need to maintain and operate the vehicle fleet, and manage available resources. In addition, a dollar savings can be realized by streamlining the VIMS and eliminating the collection, processing, and reporting of unused data.

Background

The VIMS is a set of twenty-seven programs, written in COmmon Business Oriented Language (COBOL) which performs as a base level data management system and runs on the B3500 computer. Both the Transportation and Supply squadrons process data into the VIMS from their respective operations. The primary emphasis of the VIMS is to give computer products to managers and users to help in decision making and allow data review and correction ability (14:p.2-1).

The need for a VIMS was decided at a management workshop held at Andrews AFB in October 1968. After the

preliminary assessment and subsequent field testing were accomplished VIMS was started Air Force-wide in July 1971. The sponsor of the VIMS is the Vehicle and Equipment Branch, Transportation Systems Division, Directorate of Logistics, HQ USAF/LETN, Washington DC 20330 (14:p.1-1). The primary users are all USAF vehicle maintenance shops squadrons.

The MITRE Corporation--an outside consultant firm hired by the Deputy for Command and Management Systems, Electronic Systems Division, AFSC, Hanscom AFB, Bedford, Massachusettes--examined the VIMS to "explore possible alternative techniques for improving the handling of vehicle maintenance management data [12:abstract]." They identified strengths and weaknesses and made suggestions for near-term improvements to include a restructuring of the VIMS to operate on-line. The Air Force is now testing the on-line VIMS and plans to implement the system Air Force-wide if the setup proves beneficial. Since the MITRE Corporation investigation there may have been changes in the information requirements of managers that should be examined.

Research Questions

1. What information does the VIMS provide on reports now being used by decision makers to manage the vehicle fleet?

2. What decisions are made for the management of the vehicle fleet?

3. What are the information requirements of the managers making the aforementioned decisions?

4. How does the information needed compare with the information provided by the VIMS?

5. Should omitted necessary information be added to the VIMS output?

CHAPTER II

LITERATURE REVIEW

Introduction

There are varying views on the definition and description of a decision support system (DSS). This literature review attempts to clear the confusion by examining the recent literature on the subject and analyzing it. The reader should be more familiar with DSS and the direction in which it is headed after reading this chapter.

It is not clear from reading the literature when the idea of DSS was first espoused. The concept of decision support was first articulared, according to Ralph H. Sprague, Jr. and Eric D. Carlson, in 1970 under the name of "management decision systems" by Michael S. Scott Morton (11:4). Dr. Peter G. W. Keen claims the idea began in the "late 1960s [7:33]." G. R. Wagner states that the name Decision Support Systems was given to this new concept by Dr. Keen and his associates at the Sloan School of Management at MIT in early 1970. Whenever its beginnings, DSS is being "used by an increasing number of researchers and practitioners to define a very different view [different from any of its predecessors] of computer technology applications [7:33]."

To aid in a clearer understanding of DSS, it is compared and contrasted with management information systems (MIS). Once the reader's understanding of what DSS is and how it compares to other systems is established, the chapter goes deeper into the DSS building process with discussion covering the topics of predesign considerations, system design and development, and system implementation.

Decision Support Systems Described

An initial step in attempting to understand DSS is establishing a definition of the term. According to Sprague and Carlson, DSS is interactive computer help to decision makers using data and models to solve unstructured problems (11:4). The key words are underlined in the definition. This fundamental definition is shared also by Robert Thierauf who points out that "decision makers" include managers and some operating personnel, depending on the circumstances (13:26). The literature generally excludes operators as primary users of DSS. Dr. Wagner refers to DSS as a system that provides "Executive Mind Support [17:82]." His emphasis is on the executive (individual or group) as user of the system. "It is a system that an executive uses with such intimate rapport that it seems to become part of his own mind [16:10]." Now an explanation of the term "unstructured problem" is needed.

An unstructured or semistructured problem is one where neither a manager's judgement nor data about the situation being assessed are sufficient by themselves for effective decision making (8:86). In such a circumstance both data and judgement are necessary to solve the problem. For example, when preparing a Vehicle Buy proposal management must prioritize vehicles from the ones most needed to the ones least needed. This is done because not all the vehicles in the age and condition categories to be replaced can be replaced in a single fiscal year. Therefore, tradeoffs must be considered. The computer can give the age and condition data (funds available for repair of the vehicle, fuel efficiency, and other data) necessary to determine the vehicles eligible to be replaced and provide data manipulation capability to examine the mission impact of different proposals. However, the manager must use judgement to determine where there is the greatest short- and long-term need for vehicles. No computerized decision rule is applicable all the time, nor is judgement sufficient.

Another aid to understanding DSS is identifying its characteristics and contrasting them with its predecessors, EDP and MIS. Keen declares that DSS challenges the assumptions made by EDP/MIS that: computers are useful primarily for their ability to process data, and to serve as "standardized information systems [7:33]." Steven L. Alter

explains the differences between EDP and DSS as a being embodied in the underlying philosophies of the two disciplines (2:2-3). The basic purpose of EDP is to automate the retrieval and storage of data to reduce costs, improve accuracy, and allow quick access to data concerning daily operations (increased efficiency). The philosophy of DSS emphasizes increased effectiveness within the organization as opposed to efficiency.

Sprague and Carlson use a connotational and a theoretical approach to pointing out the differences between the concepts (11:6-10). The connotational view describes EDP as a data focus entity, while the focus of MIS is on information, and DSS keys in on the decision with which the manager is faced. Theoretically, EDP/MIS is geared to management provision of structured reports required for management and control of the organization whereas, DSS is evolving from a "coalescence" of information and operations research/management science (OR/MS) technologies through interactive modeling techniques (static, using graphs and dynamic, using simulations).

Andrew Vazsonyi sums the difference between OR/MS and DSS by listing four generally accepted (by DSS proponents) observations:

1. DSS, unlike OR/MS, does not replace decision makers, but supports them: DSS is a mind support system;
2. DSS allows for the introduction of judgement, while OR/MS is normative/prescriptive;

3. DSS deals with unstructured problems, while OR/MS applies only to structured problems;
4. OR/MS comes up with solutions and recommendations, while DSS does not [15:75].

It is worth mentioning that both proponents of EDP/MIS and OR/MS tend to disagree with the limitations that DSS proponents say exist in their disciplines. The former group explains DSS as merely a subset of what their group is and will continue to be (11:4).

Predesign Analysis

After defining DSS we address the issues faced in the predesign analysis phase of a DSS development. In the predesign phase the focus is on determining what is needed versus what is available to the decision maker. The decision process is examined with an intent to develop a DSS that fills the information gaps and allows the decision maker to comfortably manipulate data based on his/her perceptions of internal and external environmental changes. We start with an analysis of the decision setting.

Keen and Scott Morton refer to the predesign phase as the "predesign cycle [8:174]." These experts suggest that the organization under study goes through at least two iterations of the predesign cycle before moving on to the design phase (8:173). In this cycle the organization analyzes the factors illustrated in Figure 2-1 to resolve preliminary problems (to the satisfaction of the user) and then moves into the design and development phase.

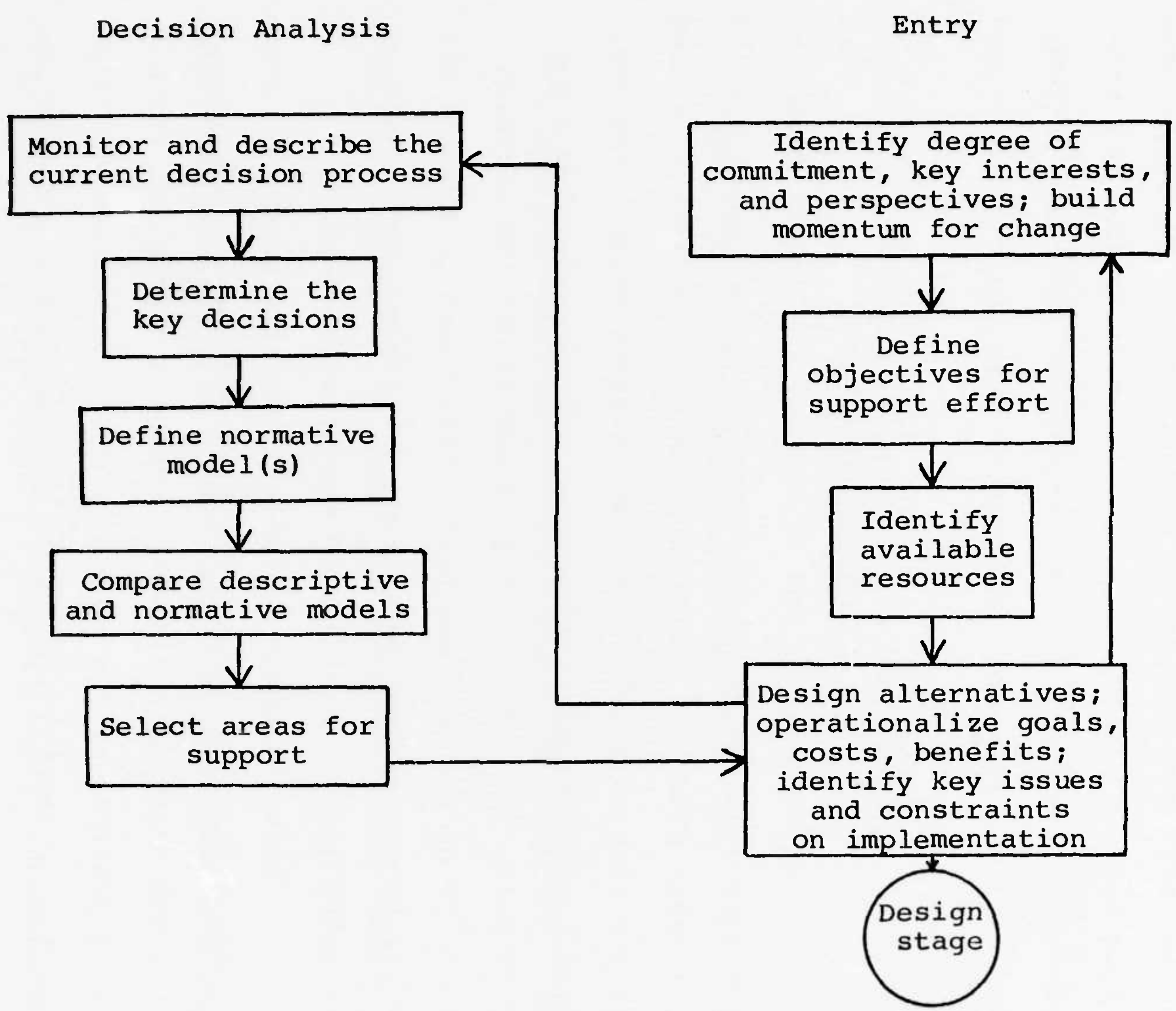


Fig. 2-1. The Predesign Cycle [8:Figure 6-1]

The first step in the decision analysis is to monitor the decision process. In this way the DSS builder can get a feel for the information needs of the decision maker. Next the key decisions should be identified along with their associated information elements. The builder can ascertain information about key decisions three ways according to Merle Martin (10:21). They are observing decision activities, interviewing decision makers, and deducing how the decision is made. All three methods are necessary because no one method provides all the information necessary under normal circumstances.

The third step in the process is to define the decision process as it should be--the normative model. The normative model is a proposal for change; it defines the range of potential designs for the DSS (8:174). The fourth step in the decision analysis is a comparison of the normative with the descriptive model--decision process as it is. The descriptive model provides a starting point from which to launch improvement efforts. Finally, the builder selects areas he/she thinks are supportable.

Under the "Entry" side of Figure 2-1 there are four areas which should be examined before moving on. The first of the four involves finding out how much of the organization's resources are committed to making an improvement in the decision process. It means uncovering the organizational motives and expectations for change and then

building the momentum to implement the agreed-upon changes. The second area for examination is ensuring the right problem is being worked. In other words, is what the builder doing in line with organizational objectives.

The objectives of the DSS must also be compared to organizational needs. Sprague and Carlson review six objectives of a DSS that fit combinations of problems that DSS can help resolve (11:94-96). Those objectives are:

1. To support difficult, underspecified decisions as well as structured well specified decisions.

2. To support decisions at all levels in the organization, whether they be strategic planning, management control, operational control, or operational performance.

3. To support communication between decision makers when there is that requirement. Decisions can be independent (when one decision maker makes the final decision), sequential interdependent (a decision maker makes a partial decision and passes it on to the next decision maker), or pooled interdependent (a decision through negotiation).

4. To support all phases of the decision-making process and promote interaction among phases. These phases include intelligence (searching the environment for potential problems), design (developing and analyzing

courses of action), and choice (choosing and implementing a course of action).

5. To support decision making with a menu of different processes to be selected at the user's choice.

6. To be flexible to respond to the user's changing needs and easy to use.

The third area of consideration is determining what resources are available for the change versus what resources are needed and coming to a satisfactory compromise. Fourth and finally, the design alternatives should be examined to find the one most suitable. At this time also, goals should be further operationalized, a cost to benefit analysis should be calculated, and key issues and limiting factors on implementation should be identified and resolved to the extent possible.

A word of caution is necessary here. In this early stage of development the cost to benefit analysis may be very inaccurate because of "the lack of specific requirements, the uncertainty of needed manpower requirements, and the inability to estimate intangibles [9:20]." For this reason, Keim and Janaro recommend a cost-benefit analysis at each step of the design process (9:20).

With the completion of the preliminary considerations, the organization is now ready to move on to the design and development stage.

System Design and Development

The design of the system includes all the system components necessary to meet the objectives enumerated in the predesign cycle. However, there is a special emphasis placed on the user interface since unless the system is effectively manipulated by the user it is rendered useless. Table 2-1, taken from Eric Carlson's article (4:Table 4.1), lists the variables under consideration when trying to design the user interface to the system.

These tradeoff variables make it possible to meet DSS objectives within the constraints of user style and available funds and technology. Consider the user whose familiarity with the computer is low, his/her control style is hands-on, and his/her desire is to minimize the amount of training necessary for working with the computer. Based on the user's strengths and limitations, the hardware output media selected may be line-at-a-time to allow the user to examine the data at his/her own pace. The input media may be a voice recognition device to avoid the user having to use a keyboard or pointing device. The software package might use prompts (questions to guide the user through the process) or menus (list of packages/routines available) to guide the user painlessly through simple subroutine calls. Another variable is the type of decision.

TABLE 2-1

TRADEOFF VARIABLES IN USER INTERFACE DESIGN

Variables	Examples of Alternatives
Hardware	
1. output media	line-at-a-time, full-screen graphics
2. input media	keyboards, pointing device, voice recognition
Software	
3. available programs	graphics subroutines, natural language parsers
4. amount of code to write	device drivers, control logic, simple subroutine calls
User	
5. interaction style	batch, slow speed, high speed
6. training constraints	will accept, must minimize
7. control style	"hands-on," tell someone else
8. familiarity with problem	low, high
9. familiarity with computer	low, high
Decision making	
10. type of decision	ad hoc, institutional
11. number of participants	few, many

DSS fall into two categories to match the type of decision under consideration. According to John J. Donovan and Stuart E. Madnick (5:79), the categories are institutional, which deals with recurring decisions and ad hoc, which deals with specific problems that are neither recurring nor anticipated. These two types of DSS have different computational needs. For example, if the decision is institutional then it is possible to build a DSS specifically for the particular decision under consideration. The annual vehicle buy in transportation is an institutional decision that can be the focus of a DSS design. If the decision is ad hoc the design of the DSS must provide for a wide variety of potential applications. In a wartime scenario the number of vehicles needed to support a base may change drastically. Because the situation has occurred infrequently, the decision maker may need the ability to simulate war conditions under different assumptions to determine the number of vehicles needed.

The last variable in the table deals with number of participants. If the number of participants is several or the user(s) change frequently, then it might be cost-effective to gear the DSS to a class of user rather than a single (or a few) decision maker(s) (18:38). This possibility is especially significant for Air Force applications, since military decision makers seldom remain at a position for more than three or four years.

The designer's job is to gather information about the decision setting and the user. He/She should analyze the decision process and build a model to use in the design of the DSS (1:1311).

Implementation

Implementation, or the lack thereof, has posed significant problems for DSS builders (2:123). This portion of the literature review will list some of the situational factors that impede and that enhance implementation. Next, it will examine some of the actions to be taken in response to these factors. And finally, the review will describe strategies to deal with risk impediments and their consequences.

Situational Factors

There are eight "risk factors" according to Steven Alter (2:157) that can affect the implementation process: (1) nonexistent or unwilling users; (2) multiple users or implementers; (3) disappearing users, implementers, or maintainers; (4) inability to specify purpose or usage in advance; (5) inability to predict and cushion impact on parties involved; (6) lack of loss of support; (7) lack of prior experience with similar systems; and (8) technical problems and cost-effectiveness issues. The risk of failure in the implementation phase is lessened to the degree these risk factors are missing from the situation. The presence

of any of these risk factors (as well as others that are less prevalent) can cripple an implementation effort if allowed to fester.

Corrective and/or Preventive Measures

However, there are actions implementers can take to lower the probability of impediments arising. Similarly, there are actions that can minimize the effects of inherent impediments once they are discovered.

For systems where users are nonexistent or unwilling, the preventive measure is to involve the intended user in the development of the system from its inception. Alavi and Henderson (1:1310) state that there is a clear need for top management support and a client or user felt need. Unless such a need is felt and the user is a participant, the system runs the risk of disuse, sporadic use, or misuse (2:161).

Where there are multiple users or implementers, communication and cooperation are vital links to system success (2:162). The implementer in this instance must make a special effort to ensure the lines of communication are open and cooperation and compromise are emphasized.

Alter (2:62) also cited turnover among users, implementers, and maintainers as a recurring and serious problem in the implementation phase. Although instances where the phenomenon was cited occurred in private industry, the

military might experience similar problems due to the transient nature of its personnel. Once a project is started it is advisable to tailor it to the general user rather than the specific individual(s) present during its development. Also, there should probably be some overlap for new personnel to learn from those who are experienced with the development process.

Empirical studies show that systems are developed sometimes without a clear notion of how they will be used (2:163). This is usually the result of overoptimism on the part of the system designer with regard to the willingness and/or ability of the user (2:132). The key here is to explain capabilities of the proposed system to the user and solicit user feedback on the intended use and usage patterns of the systems. While it is difficult to predict usage patterns accurately all the time, training the user on the capabilities of the system will help to familiarize the user with the system.

Individuals other than users, implementers, and maintainers must be prepared for their role in the process. Atler calls these individuals "feeders." They provide the data to the system (2:163). These individuals frequently are unwilling to work or change their work patterns without receiving some benefit. This problem is one which hampered the development of the VIMS. When VIMS came onboard, mileage data was collected by the vehicle operator who

commonly knew little or nothing of the VIMS and the importance of his/her role as data recorder-collector. As a result, many of these "feeders" to the system often turned in erroneous data and sometimes turned in none at all. To eradicate that problem, the Air Force went to the mileage estimator concept now used to estimate the mileage a vehicle travels based on its fuel consumption and miles per gallon data. Here as before, training and involvement may prevent feeder personnel from feeling left out or annoyed. Alter suggests that some benefit should be derived by individuals who play a feeder role--he admits though, that this is not always achieved in practice (2:164).

Lack of support can stagnate the existence of a system. The typical situation in the studies conducted revealed lack of budget to run the system or lack of management zeal to use the system properly as the culprits. The result was system death or disuse (2:Figure 28). The cure can be effected by funneling money into the system for training and operating costs.

Inexperience on the part of users or implementers will also stymie progress. Systems where users or implementers were unfamiliar with the particulars of the system effort resulted in disuse or misuse by the user and conceptual and technical design problems on the part of the implementer. Training and communication can help lessen

problems associated with a new system effort. However, a learning curve is involved and one must expect to encounter stumbling blocks.

Finally, technical problems (which are viewed also as cost-effectiveness issues) can hamper system development (2:165). These problems can be resolved with the development of redundant systems, more programming work, better software, larger computers and other things which can be resolved by an expanded budget.

Implementation Strategies

Implementation strategy should be geared to adapt to situational changes.

> Strategies for DSS design and implementation must attempt to articulate both particular decision activities that can best be supported now as well as new, more effective decision actions that may evolve [1:1309].

The strategy described is called an "evolutionary strategy [1:1312]." It involves the management of continual change and adjusting through a series of stages. The user is intimately involved in the development of the system. The system itself is developed through an iterative process where implementer/user interaction plays the key role.

> This evolutionary strategy attempts to create a mutual exchange of information about (1) the user and [implementer's] potential skills and knowledge base that might be appropriate for solving the problem, (2) potential solutions, and (3) personal critiques of these solutions. The approach hopes to utilize an interative user/[implementer] learning process as means to generate a more appropriate definition of system rquirements [1:1311].

A prototype is the product of this "learning process." Building a prototype lets the user get first-hand knowledge of system capabilities and allows the implementer to get feedback on the new concept before implementing an entire system (2:Figure 29). Even after the "final" system is in place its development throughout the life of the system should be a major concern of the organization.

Summary

The whole DSS concept can be summed in a few words: computer-based support for management decision making. The philosophy too, can be stated succinctly: computers can do more than store and retrieve data. They can be useful aids to allow decision makers the latitude to model, optimize, and simulate.

To develop this aid to decision making, predesign analysis should be undertaken to see if a DSS is needed and to what extent the organization is ready, willing, and able to take on the task of developing the needed system. Next, the design and development phase should develop the system components necessary to meet the needs outlined in the predesign phase. Finally, the implementation of the system should evolve over time to meet the changing needs of the user. The system should undergo continuous growth strategies to keep it current with the latest technological advances as well as the expanding and changing needs of the organization.

CHAPTER III

METHODOLOGY

Decision Support System Development Process

This thesis identifies information needs not currently being met by the VIMS and recommends either their inclusion into the VIMS, or their continued omission from the system. The role of the VIMS (explained in Chapter I) is to support management decisions. The computer DSS supports the manager by providing the information about the situation and the ability to manipulate that information. The better the information the more effective the decision will be in accomplishing the desired objective.

Scope and Limitations

This effort confines itself to the determination of the decisions--for which the VIMS could or does provide at least one information element--and associated information requirements of the contractor-operated and maintained vehicle fleet at Wright-Patterson Air Force Base. The process, as it is developed in this thesis, involves five steps:

1. Identify the information the VIMS provides on reports now being used by decision makers to aid their decision-making process.

2. Identify the decisions made for the management of the vehicle fleet.

3. Determine the information requirements of the managers making the aforementioned decisions.

4. Compare and contrast the information needed with the information provided by the VIMS reports being used currently.

5. Examine the potential for including omitted necessary information into the VIMS output and identifying unused information from the reports as needing further investigation to determine if the elements are used at any level of the decision-making process.

The first step in the process involved identifying the information available to decision makers via the VIMS.

The second step involved structured interviews of managers to identify the tasks they performed and decisions associated with each of those tasks. When managers displayed an inability to respond, they were prompted with an example (e.g., "If you were tasked to dispatch vehicles and you received a telephone request for a vehicle you would have to decide whether or not to respond to the call, what vehicle to send, and which driver to send?). Prompting helped the respondent to understand the question and formulate an appropriate answer.

In the third step, decision makers were further questioned about their information requirements for each

decision they made. Here too, managers were prompted when they did not know how to respond. Returning to the dispatch example in step two, the prompting followed along these lines: before you could send a vehicle to a caller you would need to know if he/she qualified for government transportation, the caller's location, destination, and time of pick up. After the decision maker listed the information needed for a decision, he (there were no female respondents) was asked about any apparent oversights. In the dispatch example for instance, if the respondent overlooked the decision to send a driver or the need for information identifying the caller's location, he was asked specifically about the oversight. In addition, the decision maker, when applicable, was questioned about the need for an analytic or forecasting model on the VIMS. In each case the decision maker was first told how a model might work and told where in the decision-making process such a model might be used beneficially. Finally, the decision maker was asked to identify the sources of the information he used. If the source was non-VIMS and VIMS provided the same information, he was asked why he chose not to use the VIMS output.

Steps one through three were combined in the interviews of all decision makers using the VIMS as a decision aid and those who could feasibly do so. After the interviewer was identified and the goal and intended benefit of

the research was explained, each interviewee was questioned in accordance with the format shown in Figure 3-1.

The fourth step involved a research design that identifies the decision, the decision maker and the information needed. The information was divided into five categories identified by an information status code:

1 = Information needed and provided by the VIMS;

2 = Information needed and provided by a source other than the VIMS;

3 = Information needed but presently unavailable;

4 = Information provided by the VIMS but not used for the decision; and

Blank space = Information neither needed nor provided.

The format is a matrix that identifies the decisions and decision makers across the top and the information elements along the side (see Figure 3-2). The numbers 1 through 4 or a blank space--corresponding to the information status code--were entered into each block according to the status of the information element corresponding to the appropriate decision. For example, if information element "U" is needed for decision reporting contractor VOC rate to Contracting (A1) and is provided by the VIMS, then a "1" was entered into the box under reporting contractor VOC rate to Contracting (A1) beside "U" as shown in Figure 3-2.

Hello, I'm Captain Fox from AFIT. I'm here to find out what information you need to help you make decisions associated with your job. The information you give me will go into a thesis effort to help persuade Air Force decision makers to furnish all of the information you think necessary to aid you in accomplishing your routine and special tasks. I'm going to ask you several questions that I'd like for you to answer as candidly as possible.

May I record this interview?

Name ______________________________

Position ___________________________

What do you do; what activities are you responsible for?

What decisions do you make in the performance of your duties?

Now let's look at each decision separately.

Decision ___________________________

- What information do you currently use to aid you in making this decision and from where does it come?

- What further information could you use if it was available?

- If forecasting is implied, ask if a forecasting tool would be useful.

- Is there anything that pertains to information requirements for this decision that I may have missed?

Fig. 3-1. Sample Interview

	Decision Maker									
	A		B			C				
Information Elements	Decision 1	2	1	2	3	1	2	3	4	5
U	1									
V										
W										
X										
Y										
X										

Fig. 3-2. Sample Information Matrix

The fifth and final step of the process examined ways to get managers and supervisors the information they need for decision making via the VIMS. It suggested the omission of unnecessary information and the inclusion of necessary information that is not now provided in VIMS reports.

Some DSS and MIS experts are critical of personal interviews as the way to determine information requirements. Merle Martin (10:14) suggests that managers too often don't know the information they require to make decisions. To get around that obstacle he recommends taking a more structured approach to the problem. He explains the System Dynamics model as one such approach. "The purpose of this model is a structured search for pertinent decisions and the information required to drive these decisions [10:15]."

Martin goes on to add that there is a great deal of literature that recommends the interview approach.

The methodology of this research followed the latter approach; it presupposed that VIMS users could best identify their information requirements. Burch, Strater, and Grudnitski confirm the validity of this approach: "Information requirements can best be stated by the users of the information [3:252]." They hasten to add, however, that the systems analyst must help users determine their requirements.

> Most individuals are guided in formulating their needs by arbitrary and often antiquated notions of what they "think" can be provided. The analyst's function, then, is to remove or expand these attitudes so that the real information requirements can be obtained [3:252].

Following the suggested pattern, interviewees were questioned about possible needs for forecasting techniques and analytical models in certain decision areas. For example, Priority Buy proposals take hours to calculate by hand. After the initial calculation, if the approving authority makes minor changes, it could take hours to recalculate the proposal. However, if an analytical model of the Priority Buy decisions rules were developed, the computer could calculate and recalculate the proposal in seconds, error free.

The result of this project should give a clearer understanding to the reader of the information requirements

on the part of the decision makers now using the VIMS in the contractor-operated vehicle sections of the 2750th Transportation Branch at Wright-Patterson Air Force Base, Ohio. Moreover, it should lead to changes in the information the VIMS provides its users so that reports are tailored to user needs. Finally, it may provide the impetus for future research in the area of information requirements for VIMS at other bases.

CHAPTER IV

ANALYSIS

Analysis of Findings

This chapter examines the findings of the study. In the following chapter these findings serve as the focal point for drawing conclusions and making recommendations for system modifications and future studies.

Research Question 1

Of the thirty-three VIMS outputs, eleven are for use by Maintenance Control and Analysis (MC/A) to edit or update VIMS files. Of the remaining twenty-two outputs, only five are used as decision aids by the decision makers interviewed in this study. These five reports include the following:

1. Vehicle Out of Commission (VOC) Report--tells the quality assurance evaluators (QAE) how the contractor's VOC rate compares with the allowable quality level (AQL) the Vehicle Maintenance Section has contracted to comply with;

2. Work Order Master File Status Report--shows all work orders (w/o) on the master file in numerical sequence;

3. Vehicle Master List--sequenced by management code (List A) and assigned organization (List B). Shows static and dynamic data for all vehicles for which vehicle maintenance has primary responsibility.

4. Scheduled Maintenance Report (Shop Copy)--prints only vehicles overdue scheduled maintenance miles/hours/kilometers and dates, and those coming due.

5. Vehicle Static Maintenance Data List--made up upon request to print a specific vehicle's or all vehicles' static data.

Explanations of the output vocabulary used in the five reports (14:pp.4-78,4-79,4-84,4-85,4-87 to 4-89,7-9,7-10) are shown in Table 4-1. Table 4-2 explains the information elements obtained from other-than-VIMS sources.

Research Question 2

The information elements in Table 4-1 and Table 4-2, from the VIMS and non-VIMS sources, are used to make decisions concerning the base vehicle fleet. The decision makers and the decisions they made that lend themselves to being supported by the VIMS are depicted in Table 4-3.

Research Question 3

There are three categories of information needed by managers; the first is provided by the VIMS; the second is supplied by non-VIMS sources; and the final set of information is that information which is to date unavailable.

TABLE 4-1

VIMS OUTPUT VOCABULARY DESCRIPTIONS

Information Element	Description
	1. VOC Report
Veh Group Code	Numerical code used to group vehicles for VOC reporting, Security Police, Materials Handling including, Equipment (MHE), etc.
Mgmt Code	USAF management code to which the vehicles in the group belong, C108 wrecker, B101 sedan, etc.
VDM Hrs	Hours, month-to-date, that vehicles within USAF management codes within groups are deadlined for maintenance.
VDP Hrs	Hours, month-to-date, that vehicles within USAF management codes within groups are deadlined for parts.
VOC Hrs	Hours, month-to-date, that vehicles within USAF management codes within groups are out of commission for parts or maintenance.
Work Orders Open	Work orders for vehicles within USAF management codes within groups that are "open" at the time the report is printed.
Inventory	Number of vehicles assigned within management code groups.
Available Hrs	Hours vehicle available, using the 24-hour clock, for the month up to 0800 hours the day after the as-of date on the report.

TABLE 4-1--Continued

Information Element	Description
VDM%	VDM Hrs divided by Available Hrs, given for "SERIES TOTAL," "GROUP TOTAL," and "FLEET TOTAL."
VDP%	VDP Hrs divided by Available Hrs, given for "SERIES TOTAL," "GROUP TOTAL," and "FLEET TOTAL."
VOC%	VOC Hrs divided by Available Hrs, given for "SERIES TOTAL," "GROUP TOTAL," and "FLEET TOTAL."
	2. Work Order Master File Status Report
Work Order	Work order number.
Veh Reg Number	Vehicle registration number that is assigned to the vehicle.
Mgmt Code	USAF management code to which the vehicle belongs.
Work Center	Work center code, in this instance any one of the five: buildings 60, 58, 142, 52, or 38.
Date/Time Rec'd	Date and time the work order was opened.
Date/Time Rel'd	Date and time the work order was closed.
Date Delayed	Date and time the work order was put on delayed maintenance.
Work Order Status	Gives information of all open and recently closed work orders in the VIMS master file.
W/O Indicator	Gives added information about the work order.

TABLE 4-1--Continued

Information Element	Description
	3. Vehicle Master List
Mgmt Code	USAF management code to which the vehicles in the group belong.
Veh Reg Number	Vehicle registration number that vehicle is assigned to.
Nat'l Stk Number	National stock number assigned to the vehicle.
Make/Type	Make and type of vehicle.
Sched Maint Ind	Scheduled maintenance indicator shows vehicle is on the scheduled maintenance list.
Delayed Maint Ind	Delayed maintenance indicator an asterisk shows the vehicle is on the Delayed Maintenance List.
Veh Group Code	Code used to group vehicles for VOC reporting.
Nuclear Cert Ind	Nuclear certified indicator, an "N" shows the vehicle has been declared nuclear certified.
WRM Ind	Used to identify vehicles which are war readiness materials.
W/O Closed	Number of work orders closed on the vehicle for the month.
RC/CC Code	Responsibility center/cost center code for the vehicle.
R/D Code	Reimbursable/distribution code for the vehicle.
Own Cmd	Major command that owns the vehicle.

TABLE 4-1--Continued

Information Element	Description
Use Cmd	Major command using the vehicle.
Asg Org	Organization to which the vehicle is assigned.
Fuel Type	Type fuel used by the engine of the vehicle.
Utilization Code	Shows measurement of utilization; mile, hour, unit, kilometer code.
Stand Price	Standard price of the vehicle.
1 Time Rep Limit	One time repair limit, the maximum dollar amount that can economically be spent on the vehicle at any one time.
Current M/H/K	Cumulative miles/hours/kilometers from either the last actual reading, plus any add-on mileage, or the estimated m/h/k from the fuel inputs.
Acceptance Date	Date the vehicle was accepted by the USAF.
Rebuild Date	Depot rebuild date.
Replacement Code	Vehicle's position for replacement eligibility in accordance with TO 00-25-249.
War Exp Date M/H/K	Warranty expiration date, date and m/h/k the manufacturer's warranty expires.

TABLE 4-1--Continued

Information Element	Description
Amortization Date	The year and month the vehicle is fully amortized in accordance with TO 00-25-249.
Vehicle Equiv	Vehicle equivalent from AFM 77-310, Volume II.
	4. Scheduled Maintenance Report (Shop Copy)
Veh Reg Number	Vehicle registration number that vehicle is assigned to.
Mgmt Code	USAF management code to which the vehicle belongs.
Make/Type	Make and type of vehicle.
Asg Org	Organization to which the vehicle is assigned.
Odometer M/H/K	Cumulative miles/hours/kilometers less any add-on.
Safety Due	If an inspection is due within 1000 miles/100 hours/or 1600 kilometers from the date of this product the due m/h/k or date will appear here.
Sch/LOF Due	If a scheduled/lube oil and filter inspection is due within 1000 miles/100 hours/or 1600 kilometers from the date of this product the due m/h/k or date will appear here.
Special -1 Due	If a special -1 inspection is due within 1000 miles/100 hours/ or 1600 kilometers from the date of this product the due m/h/k or date will appear here.

TABLE 4-1--Continued

Information Element	Description
Special -2 Due	If a special -2 inspection is due within 1000 miles/100 hours/ or 1600 kilometers from the date of this product the due m/h/k or date will appear here.
Special -3 Due	If a special -3 inspection is due within 1000 miles/100 hours/ or 1600 kilometers from the date of this product the due m/h/k or date will appear here.
Week Due	A "01," "02," "03," or "04" will be printed to indicate the specific week due, "XX" if scheduled maintenance is overdue.
In-Shop	An "XX" will be here if vehicle is in the shop and a work order has been opened on it.
	5. Vehicle Static Maintenance Data List
Veh Reg Number	Vehicle registration number that vehicle is assigned to.
Mgmt Code	USAF management code to which the vehicle belongs.
Utilization Code	Shows measurement of utilization: mile, hour, unit, kilometer code.
Repl Miles, Q,M,J	Mileage at which a vehicle moves to replacement code "Q," "M," or "J."
Cube L/W/H	Vehicle cube, width, length, and height.
Life Exp Year	Expected life of the vehicle in years.

TABLE 4-1--Continued

Information Element	Description
Special -1 Due	If a special -1 inspection is due within 1000 miles/100 hours/ or 1600 kilometers from the date of this product the due m/h/k or date will appear here.
Special -2 Due	If a special -2 inspection is due within 1000 miles/100 hours/ or 1600 kilometers from the date of this product the due m/h/k or date will appear here.
Special -3 Due	If a special -3 inspection is due within 1000 miles/100 hours/ or 1600 kilometers from the date of this product the due m/h/k or date will appear here.
Safety Due	If an inspection is due within 1000 miles/100 hours/or 1600 kilometers from the date of this product the due m/h/k or date will appear here.
Sch/LOF Due	If a scheduled/lube oil and filter inspection is due within 1000 miles/100 hours/or 1600 kilometers from the date of this product the due m/h/k or date will appear here.
Interval M/H/K Mo	Miles/hours/kilometers and number of months intervals that the special inspection (1, 2, or 3), sch/LOF, and safety inspection are due.

TABLE 4-2

NON-VIMS OUTPUT VOCABULARY DESCRIPTIONS

Information Element	Description
Org Priority	Priority assigned the organization by the installation commander.
Min Essential Veh	Minimum number of vehicles without which the user can no longer perform the mission.
Better Use For Veh	In the judgement of the decision maker, the vehicle can better serve the mission in another organization.
User Need For Veh	What the present user does with the vehicle.
Vehicle Condition	Physical appearance and mechanical condition of the vehicle or vehicles of present user.
Nomenclature	Nomenclature as designated on the Vehicle Authorization Listing (VAL).
Manufacturer	Manufacturer of the vehicle, International Harvester, General Motors, etc.
Serial Number	Manufacturer's vehicle identification number.
Nbr Veh Auth	Total number of vehicles authorized the authorization.
Repair Estimate	The total cost to make the vehicle safe and serviceable.
Type of Repairs	Parts and manhours necessary to make the vehicle safe and serviceable.

TABLE 4-2--Continued

Information Element	Description
Expected Life	Life expectancy of the vehicle after the proposed repairs have been made.
Eligible RCs	Replacement codes eligible to be entered on the Vehicle Priority Buy.
Veh Due-In	Number and type of vehicles due-in from previous vehicle buys.
AQL	Allowable Quality Level, as per contract, the maximum VOC% allowed per vehicle category.
Nbr VOC/Cat	Number of vehicles out of commission per vehicle category.
Time In Shop	Total time the vehicle has been in the shop waiting for repairs to be completed.
Nbr Seasonal Veh	The number of seasonal vehicles needing repairs, snow plows, lawn mowers, etc. and their anticipated use in the near future.
Items/Service	Service and/or items purchased on the bill sent by the vendor.
Item Cost	Cost of the item on the bill.
Item Quantity	Quantity of items purchased.
Item's Fair Price	Fair and reasonable price for the item.

TABLE 4-2--Continued

Information Element	Description
Circumstances	Unusual circumstances associated with the purchase of the item.
Date Veh Insp	Date of the last vehicle inspection by vehicle maintenance.
Manpower Avail	Numbers and skill levels of manpower available either in shop or in the available labor pool of potential employees.
Workload/Center	Average yearly workload per vehicle maintenance work center.
Total Vehicles	All vehicles on base that vehicle maintenance is responsible for.
Breakdown Prob	Probability of breakdowns in each vehicle category, general purpose, special purpose, MHE, construction/base maintenance, and military design.
Freq Use Parts	Parts used most frequently, enough to warrant an inventory.
Parts Cost	Cost of parts needed in the inventory.
Whse Avail	Storage space available for parts inventory.
Salaries	Salary requirements of prospective employees.
Manpower Effic'y	How quickly and effectively employees are able to perform assigned tasks.

TABLE 4-2--Continued

Information Element	Description
Parts Use Rate	Number of parts used to repair vehicles over time.
Order Costs	Time and expense required to order parts.
Receiving Costs	Time and expense required to get parts after they have been ordered.

TABLE 4-3

DECISION TABLE

Decision Maker	Decisions
A. Quality Assurance Evaluator	1. Report contractor VOC rate to Contracting.
	2. Amend Work Order Master File Status Report.
B. Vehicle Maintnenace Manager and Deputy	1. Amend Work Order Master File Status Report.
	2. Report unfavorable errors in the VOC rate to QAE and/or Contracting.
	3. Establish an initial parts inventory.
	4. Establish an initial manning level.
	5. Placing mechanics throughout the various work centers.
	6. Replenish inventory stock.
C. Vehicle Maintenance Analyst	1. Establish maintenance priorities for vehicles entering the shop.
	2. Temporary redistribution of manpower.
	3. Call users to schedule vehicle inspections.

TABLE 4-3--Continued

Decision Maker	Decisions
D. Vehicle Operations Manager and Deputy	1. Recommend vehicle disposition to VAUB.
	2. Recommend to VAUB organization to receive new vehicle.
E. Vehicle Fleet Manager	1. Recommend priority buy to VAUB.
	2. Recommend to Vehicle Operations Deputy Manager rotation and reassignment of vehicles.
	3. Pull an organization's vehicle(s).
F. Billing Agent	1. Validate off-base purchases/expenditures associated with base vehicles.

All of the information elements previously discussed and the decisions of the specific decision makers compiled in Tables 4-1 through 4-3 are combined in Table 4-4 to show the information necessary for each decision as stated by the decision maker. The information will be divided into five categories identified by an information status code:

1 = Information needed and provided by the VIMS;

2 = Information needed and provided by a source other than the VIMS;

3 = Information needed but presently unavailable;

4 = Information provided by the VIMS but not used for the decision; and

Blank space = Information neither needed nor provided.

These status codes are placed in the blocks corresponding to the decisions and information elements to which they make reference. The results of the study are summarized in Table 4-4. From these summarized results we can draw conclusions about the adequacy of the VIMS support for each decision.

Research Question 4

The analysis follows each information element (or group of elements if similar status codes apply to more than one element) and the associated status codes for each decision.

TABLE 4-4

INFORMATION REQUIREMENTS MATRIX

Information Elements	Decision Maker																
	A		B						C			D		E			F
	Decisions																
	1	2	1	2	3	4	5	6	1	2	3	1	2	1	2	3	1
<u>VIMS</u>																	
Veh Group Code	1			1					1			4	4	4	4	4	4
Mgmt Code	1	1	1	1					1		4	1	1	1	1	4	4
VDM Hrs	4			1					1								
VDP Hrs	4			1					1								
VOC Hrs	1			1					1	2							
Work Orders Open	4			1					4								
Inventory	4			1					4								
Available Hrs	1			1					1	2							
VDM%	4			1					1								
VDP%	4			1					1								
VOC%	1			1					1	2							
Work Order		1	1						4								
Veh Reg Number		1	1						1		1	1	1	4	1	1	1
Work Center		1	1						1								
Date/Time Rec'd		1	1						1								

TABLE 4-4--Continued

Information Elements	Decision Maker / Decisions: A 1	A 2	B 1	B 2	B 3	B 4	B 5	B 6	C 1	C 2	C 3	D 1	D 2	E 1	E 2	E 3	F 1
Date/Time Rel'd		1	1						1								
Date Delayed		1	1						1								
Work Order Status		1	1						1								
W/O Indicator		1	1						1								
Nat'l Stk Number												1	1	1	1	4	4
Make/Type											1	1	1	4	1	1	1
Sched Maint Ind												4	4	4	4	4	4
Delayed Maint Int												4	4	4	4	4	4
Nuclear Cert Ind												4	4	4	4	4	4
WRM Ind												4	4	4	4	4	4
W/O Closed												4	4	4	4	4	4
RC/CC Code												4	4	4	4	4	4
R/D Code												4	4	4	4	4	4
Own Cmd												4	4	1	1	4	4
Use Cmd												4	4	4	1	4	4
Asg Org									2	1	1	1	1	1	1	1	1
Fuel Type												4	4	4	4	4	1

TABLE 4-4--Continued

Information Elements	A		B						C			D		E			F
	Decisions																
	1	2	1	2	3	4	5	6	1	2	3	1	2	1	2	3	1
Utilization Code									4			4	4	4	4	4	1
Stand Price												1	1	1	4	4	4
1 Time Rep Limit												1	4	4	1	4	4
Current M/H/K												1	1	4	1	1	1
Acceptance Date												1	1	4	4	4	4
Rebuild Date												4	4	4	4	4	4
Replacement Code												1	1	1	1	4	4
War Exp Date M/H/K								1				1	4	4	4	4	1
Amortization Date												1	4	4	4	4	4
Vehicle Equiv												4	4	4	4	4	4
Odometer M/H/K											1						
Safety Due									1		1						
Sch/LOF Due									1		1						
Special -1 Due									1		1						
Special -2 Due									1		1						
Special -3 Due									1		1						
Week Due											1						

TABLE 4-4--Continued

Information Elements	A 1	A 2	B 1	B 2	B 3	B 4	B 5	B 6	C 1	C 2	C 3	D 1	D 2	E 1	E 2	E 3	F 1
Repl Miles Q,M,J									4								
Cube L/W/H									4								
Life Exp Year									4								
Interval M/H/K Mo									4								
In-Shop											1						
Non-VIMS																	
Org Priority									2			2	2			2	
Min Essential Veh																2	
Better Use For Veh																2	
User Need For Veh									2				2			2	
Vehicle Condition												2	2			2	
Nomenclature												2	2				
Manufacturer												2	2				
Serial Number												2	2				
Nbr Veh Auth													2				
Repair Estimate												2					

TABLE 4-4--Continued

Information Elements	Decision Maker A: Decisions 1	A 2	B 1	B 2	B 3	B 4	B 5	B 6	C 1	C 2	C 3	D 1	D 2	E 1	E 2	E 3	F 1
Type of Repairs									2	2		2					
Expected Life												2					
Eligible RCs																2	
Veh Due-In																2	
AQL	2			2			2		2	2							
Nbr VOC/Cat				2					2	2							
Time In Shop									2	2							
Nbr Seasonal Veh							2		2	2							
Items/Service																2	
Item Cost																2	
Item Quantity																2	
Item's Fair Price																2	
Circumstances																2	
Date Veh Insp																2	
Manpower Avail						2	2			2							
Workload/Center							2										
Total Vehicles					2	2	2										

TABLE 4-4--Continued

Information Elements	Decision Maker A: Decision 1	A: 2	B: 1	B: 2	B: 3	B: 4	B: 5	B: 6	C: 1	C: 2	C: 3	D: 1	D: 2	E: 1	E: 2	E: 3	F: 1
Breakdown Prob						2	2										
Freq Use Parts					2												
Parts Cost					2												
Whse Avail					2												
Salaries						2											
Manpower Effic'y						2	2			2							
Parts Use Rate					2			2									
Order Costs					2			2									
Receiving Cost								2									
<u>Unavailable</u>																	
Analytic Model							3							3			
Forecast Model					3	3									3		

The first group of information elements are used by the individual decision makers every time they are provided by the VIMS (status code "1"). The following information elements are used in amending the Work Order Master File Status Report (A2), amending the Work Order Master File Status Report (B1), and establishing maintenance priorities for vehicles entering the shop (C1):

1. Work Center
2. Date/Time Rec'd
3. Date/Time Rel'd
4. Date Delayed
5. Work Order Status
6. W/O Indicator

These element should remain as they are.

The next set of information elements within the first group, are used in establishing maintenance priorities for vehicles entering the shop (C1) and calling users to schedule vehicle inspections (C3), or in calling users to schedule vehicle inspections (C3) only (6, 7, and 8):

1. Safety Due
2. Sch/LOF Due
3 Special -1 Due
4. Special -2 Due
5. Special -3 Due

6. Week Due

7. In-Shop

8. Odometer M/H/K

These too, should be left as they are.

The second group of elements are obtained from non-VIMS sources for certain decisions even though they are provided by the VIMS (status code "2"). The first set in this second group are used in temporarily redistributing manpower (C2):

1. VOC Hrs

2. Available Hrs

3. VOC%

The Vehicle Maintenance Analyst, in this instance, needs current information and the VIMS product is, at least, twenty-four hours old. Therefore, he keeps a manual record of the three information elements and updates them as frequently as necessary. An on-line/real-time VIMS would resolve the problem by allowing the decision maker to update the VIMS output as often as required eliminating the need for a separate tally.

The second set of the second information group contains a single element: Asg Org. It is used in establishing maintenance priorities for vehicles entering the shop (C1). The Vehicle Maintenance Analyst has a wall chart displaying every vehicle in the fleet, by registration number, and the organization to which it is assigned.

Because the wall chart is easier to use than a VIMS report, the chart is probably the source to use. This requires no adjustment to the VIMS since every other time where "Asg Org" is provided, it is used.

The third group of information elements are those needed elements which are not provided by the VIMS and are obtained from other sources. "Nomenclature," "Manufacturer," and "Serial Number" are used in recommending vehicle disposition to the VAUB (D1) and recommending to the VAUB the organization to receive a new vehicle (D2). All of these elements (in addition to others) are provided by the VAL, a Supply Squadron computer output. It seems practical to add these to the VIMS to preclude the necessity of using more than one report each for the aforementioned decisions.

Another element of group three elements is "Org Priority," used in recommending vehicle disposition to the VAUB (D1), recommending to the VAUB the organization to receive a new vehicle (D2), establishing maintenance priorities for vehicles entering the shop (C1), and pulling an organization's vehicle(s) (E3). An organization's priority is not likely to change and is simple to enter into the VIMS. As a result, it should be entered into the system.

"User Need For Veh" is used in establishing maintenance priorities for vehicles entering the shop (C1),

recommending to the VAUB the organization to receive a new vehicle (D2), and pulling an organization's vehicle(s) (E3). This information is outlined in a vehicle justification form (AF Form 1374), sometimes in excess of two pages long, for each vehicle in the fleet (1249). Such a voluminous collection of data would require great pains to load into the VIMS. However, an abbreviated respresentation of the data could more easily be added to include the expected number of M/H/K and a short field (thirty characters) describing the vehicle's primary intended use.

"Vehicle Condition" is used in recommending vehicle disposition to the VAUB (D1), recommending to the VAUB the organization to receive a new vehicle (D2), and pulling an organization's vehicle(s) (E3). Since this information is necessarily obtainable through a visual inspection of the vehicle, it is an unlikely candidate for inclusion in the VIMS.

"Nbr Veh Auth" is used only in recommending to the VAUB the organization to receive a new vehicle (D2). This element is obtained from the VAL and should be included in the VIMS to reduce the number of information sources a manager must use.

"Type of Repairs" is an element used in establishing maintenance priorities for vehicles entering the shop (C1), temporarily redistributing manpower (C2), and recommending vehicle disposition to the VAUB (D1). For

each of these decisions the information has to be current and therefore on-line/real-time VIMS is the problem's resolution.

"Repair Estimate" and "Expected Life" are both used in recommending vehicle disposition to the VAUB (D1). Again, because of the need for current information, and also because of the effort required to computerize the information, the mechanic making the analysis is the logical source for the information.

Pulling an organization's vehicle(s) (E3) is the only decision for which "Min Essential Veh," "Better Use For Veh," "Eligible RCs," and "Veh Due-In" are required. "Min Essential Veh" is approved by the VAUB and changes infrequently. It should be included in the VIMS. "Eligible RCs," and "Veh Due-In" are obtained from the MAJCOM and could be included in the VIMS with a minimum of effort. "Better Use For Veh" is obtained via the decision maker's judgement, and does not lend itself to computerization.

"AQL" is used in reporting contractor VOC rate to Contracting (A1), reporting unfavorable errors in the VOC rate to QAE or Contracting (B2), placing mechanics throughout the various work centers (B5), establishing maintenance priorities for vehicles entering the shop (C1), and temporarily redistributing manpower (C2). This information is part of the contract between Procurement and the

contractor for each vehicle category of VOC. Because it seldom changes and is easily entered into the system, it seems practical to add it to the VIMS.

"Nbr VOC/Cat" is used in reporting unfavorable errors in the VOC rate to QAE or Contracting (B2), establishing maintenance priorities for vehicles entering the shop (C1), and temporarily redistributing manpower (C2). It is obtained by counting the vehicles in a particular category on the Vehicle Maintenance wall chart. To get the information via the VIMS the system would have to add the vehicles out of commission per VOC category and total them on the report. The VIMS already gathers the data so it seems practical to include the totals. Also, the need for current information requires on-line VIMS.

"Time In Shop" is used in establishing maintenance priorities for vehicles entering the shop (C1) and temporarily redistributing manpower (C2). It is obtained from the shop work order for its timeliness. The VIMS collects the data and on-line appoication could solve the timeliness problem.

"Nbr Seasonal Veh" is used in placing mechanics throughout the various work centers (B5), establishing maintenance priorities for vehicles entering the shop (C1), and temporarily redistributing manpower (C2). The element is obtained checking the wall chart; however, a vehicle could be coded in the VIMS to identify it as seasonal.

The following information elements are used in validating off-base purchases and expenditures associated with base vehicles (F1):

1. Items/Service
2. Item Cost
3. Item Quantity
4. Item's Fair Price
5. Circumstances
6. Date Veh Insp

These elements are obtained by questioning the user. Occasions requiring the use of such information are infrequent; therefore, VIMS is not the best source.

"Manpower Avail" and "Manpower Effic'y" are used in establishing an initial manning level (B4), placing mechanics throughout the various work centers (B5), and temporarily redistributing manpower (C2). Both elements are obtained via observation and are not likely to be computerized.

"Workload/Center" is used in the decision to place mechanics throughout the various work centers (B5). The information is obtained during contract talks and is best left there because it is needed infrequently. The element should not be included in the VIMS.

"Total Vehicles" is obtained during the contract talks and requires the VIMS to total the vehicles in each replacement category and sum them to get the information.

The information is used in establishing an initial parts inventory (B3), establishing an initial manning level (B4), and placing mechanics throughout the various work centers (B5).

"Breakdown Prob" is used in establishing an initial manning level (B4) and placing mechanics throughout the various work centers (B5). This information is obtained during contract talks. And would be an impractical addition to the VIMS because it is needed infrequently.

"Salaries" are obtained in employee interviews and are used in establishing an initial manning level (B4). This information has a one-time use and is not a likely candidate for the VIMS.

"Freq Use Parts," "Parts Cost," and "Whse Avail" are used in establishing an initial parts inventory (B3). "Parts Cost" is obtained from a parts price list. Since the list changes so frequently, it might be best to leave it out of the VIMS. "Freq Use Parts" and "Whse Avail" are discussed during contract talks and seem unlikely to include in the VIMS.

"Receiving Cost" is used in replenishing inventory stock (B6) and is computed by costing the resources used to get the part or a bill for shipping costs. It seems impractical to insert such information into the VIMS.

"Parts Use Rate" and "Order Costs" are used in establishing an initial parts inventory (B3) and

replenishing inventory stock (B6). The information is obtained via experience or, in the case of "Order Costs," calculating the manpower and time used to order parts plus any fee imposed by the seller. The two elements seem likely VIMS candidates.

The fourth group of information includes necessary information that is unavailable from any source. This group includes analytic models for placing mechanics throughout the various work centers (B5) and recommending a priority buy to the VAUB (E1). And it also includes forecast models for establishing an initial parts inventory (B3), establishing an initial manning level (B4), and recommending to the Deputy Manager for Vehicle Operations vehicle rotations and reassignments (E2). The prospect of adding these models to the VIMS requires a cost/benefit analysis to determine benefit of such additions.

The fifth group of information is that information which is provided by the VIMS and never used. They include:

1. Repl Miles Q,M,J
2. Cube L/W/H
3. Life Exp Year
4. Interval M/H/K Mo
5. Vehicle Equiv
6. Sched Maint Ind
7. Delayed Maint Ind

8. Nuclear Cert Ind
9. WRM Ind
10. W/O Closed
11. RC/CC Code
12. R/D code
13. Rebuild Date

These information elements need further investigation up the decision chain to find if they are used at all. If an element is unused for a decision, it should be dropped from the associated report. However, if the element is never used, the data should no longer be collected.

The sixth and final group is comprised of elements that are provided by the VIMS but are unnecessary for at least one decision for which it is provided. The following elements are included in this group:

1. Veh Group Code
2. Mgmt Code
3. VDM Hrs
4. VDP Hrs
5. Work Orders Open
6. Inventory
7. VDM%
8. VDP%
9. Work Order
10. Veh Reg Number
11. Nat'l Stock Number

12. Make/Type
13. Own Cmd
14. Use Cmd
15. Fuel Type
16. Utilization Code
17. Stand Price
18. 1 Time Rep Limit
19. Current M/H/K
20. Acceptance Date
21. Replacement Code
22. War Exp Date M/H/K
23. Amortization Date

All of these elements should simply be deleted from reports that support decisions where the information is unnecessary and retained on reports where the information is needed.

Summary

The information elements fall into six groups that help the reader distinguish between elements. Table 4-5 summarizes the analysis of the previous paragraphs.

TABLE 4-5

SUMMARY ANALYSIS

<u>Group one</u>--information elements used by the individual decision makers every time they are provided by the VIMS

Work Center	Safety Due
Date/Time Rec'd	Sch/LOF Due
Date/Time Rel'd	Special -1 Due
Date Delayed	Special -2 Due
Work Order Status	Special -3 Due
W/O Indicator	Week Due
Odometer M/H/K	In-Shop

<u>Group two</u>--information provided by VIMS but managers use other sources

*	VOC Hrs	*	VOC%
*	Available Hrs		Asg Org

<u>Group three</u>--needed information elements not provided by the VIMS

v	Org Priority		Items/Service
v	Min Essential Veh		Item Cost
	Better Use For Veh		Item Quantity
p	User Need For Veh		Item's Fair Price
	Vehicle Condition		Circumstances
v	Nomenclature		Date Veh Insp
v	Manufacturer		Manpower Avail
v	Serial Number		Workload/Center
v	Nbr Veh Auth	v	Total Vehicles
	Repair Estimate		Breakdown Prob
*	Type of Repairs		Freq Use Parts
	Expected Life		Parts Cost
v	Eligible RCs		Whse Avail
v	Veh Due-In		Salaries
v	AQL		Manpower Effic'y
v	Nbr VOC/Cat	v	Parts Use Rate
*	Time In Shop	v	Order Costs
v	Nbr Seasonal Veh		Receiving Cost

* = on-line/real-time VIMS needed for this information.

v = information should be added to the VIMS.

p = parts of the information can be integrated into the VIMS.

TABLE 4-5--Continued

Group four--models--needed information	
Analytical Models	Forecasting Models
Group five--information elements provided by the VIMS and not used	
WRM Ind	Life Exp Year
W/O Closed	Interval M/H/K Mo
RC/CC Code	Sched Maint Ind
R/D Code	Delayed Maint Ind
Rebuild Date	Nuclear Cert Ind
Repl Miles Q,M,J	Vehicle Equiv
Cube L/W/H	
Group six--elements provided by the VIMS but unnecessary for at least one decision	
Veh Group Code	Make/Type
Mgmt Code	Own Cmd
VDM Hrs	Use Cmd
VDP Hrs	Fuel Type
Work Orders Open	Utilization Code
Inventory	Stand Price
Available Hrs	1 Time Rep Limit
VDM%	Current M/H/K
VDP%	Acceptance Date
Work Order	Replacement Code
Veh-Reg Number	War Exp Date M/H/K
Nat'l Stk Number	Amortization Date

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

Study Conclusions and Recommendations

Research Question 5

The VIMS either provides or has the capacity to provide most of the information required for the decisions under study in this thesis. However, there are problems that arise out of the format of the outputs, their number, and their timeliness. These problems could be resolved by:

1. Formating the information and structuring the reports to fit particular decisions;

2. Including only the information necessary to the decision in the report; and

3. Providing an on-line/real-time VIMS--as suggested in the MITRE study.

For example, since decisions to establish an initial parts inventory (B3) and to replenish inventory stock (B6) share a need for similar information, all of the information necessary for them both could be provided on a single report entitled "Parts Inventory Decisions." Included in the report would be only the information necessary for parts inventory decisions. This would

provide a single report for these two decisions. If part totals are required, then the report would provide totals and not leave the decision maker to count the parts entries. Moreover, if the test for on-line/real-time VIMS is successful, then it should be installed at all Air Force bases and sites where there is a VIMS.

Another issue is the existence of unused (and perhaps unnecessary) data on the VIMS outputs. The above suggestion would also alleviate this problem. Information elements like "nuclear certification indicator" or "WRM indicator" which are used only in wartime or exercise scenarios could be reported on special outputs as needed and not included on scheduled reports. The problem of information appearing on several reports even though it is not used would likewise be resolved--scheduled maintenance indicator, delayed maintenance indicators, and safety inspection data on the Vehicle Master List, Vehicle Static Maintenance Data List, and Scheduled Maintenance Report.

From installation to installation information requirements may differ. The reports generated too should differ to facilitate their use. Each base should change the content and format of their reports as the need arises. Reports should either suit the decision maker--civilian operation--or the decision itself--military decision makers (18:40-47).

The final recommendation concerns regular review of information needs and new developments that may improve the information processes. Users and builders should regularly--perhaps once a year--discuss the need for more or less information, format changes for reports, and technological developments that can improve either the effectiveness or efficiency of the present system. In this way the system constantly evolves addressing the new issues in a changing environment. Ten or more years is too long to go without making adjustments to the system.

Recommendations for Future Study

This thesis is limited in its scope and therefore the results may not be generalizable to all contract operations attending to Vehicle Maintenance and Vehicle Operations functions. Therefore, further research is recommended in this topical area to include contractor and non-contractor operated functions Air Force-wide.

One way of conducting such a study would be to send out surveys questioning managers' use of resources and associated information requirements. Perhaps questions could center around general decision areas like parts inventory, or manpower placement, or training, or any other areas relevant to the operation. Perhaps a more structured approach to determining those requirements is desirable (10:15). Nevertheless, such information could save the

Air Force some of the dollars it spends collecting, storing, and processing unused data. The findings could also make the system more effective by providing the necessary information and data manipulation capability now needed but lacking in the VIMS.

Another approach to the same problem would be to conduct a study of information requirements at a government-operated function and compare the differences between the private and government information requirements. With the growth of the information industry and the vast technological developments taking place today, the Air Force might do well to closely monitor, modify, and update its VIMS.

SELECTED BIBLIOGRAPHY

A. REFERENCES CITED

1. Alavi, Maryam, and John C. Henderson. "An Evolutionary Strategy for Implementing a Decision Support System," Management Science, Vol. 27, No. 11 (November 1981), pp. 1309-1323.

2. Alter, Steven L. Decision Support Systems: Current Practices and Continuing Challenges. Reading MA: Addison-Wesley Publishing Company, 1980.

3. Burch, John G., Jr., Gary Grudnitski, and Felix Strater. Information Systems: Theory and Practice. 2d ed. New York: Wiley and Sons, Inc., 1979.

4. Carlson, Eric D. "Developing the User Interface for Decision Support Systems." In John L. Bennett, ed., Building Decision Support Systems. Menlo Park CA: Addison Wesley Publishing Company, 1983.

5. Donovan, John J., and Stuart E. Madnick. "Institutional and Ad Hoc DDS and Their Effective Use," Data Base, Vol. 8, No. 3 (Winter 1977), pp. 79-88.

6. Fitter, Mike, and Max Sime. "Creating Responsive Computers: Responsibility and Shared Decision Making." In H. T. Smith and T. R. G. Green, eds., Human Interaction with Computers. New York: Academic Press, Inc., 1980.

7. Keen, Peter G. W. "Decision Support Systems: Translating Analytic Techniques into Useful Tools," Sloan Management Review, Vol. 21, No. 3 (Spring 1980), pp. 33-34.

8. ________, and Michael S. S. Morton. Decision Support Systems: An Organizational Perspective. Reading MA: Addison-Wesley Publishing Company, 1978.

9. Keim, Dr. Robert T., and Dr. Ralph Janaro. "Cost/Benefit Analysis of MIS," Journal of Systems Management, September 1982, pp. 20-25.

10. Martin, Merle P. "Determining Information Requirements for Requirements," Journal of Systems Management, December 1982, pp. 14-21.

11. Sprague, Ralph H., and Eric D. Carlson. Building Effective Decision Support Systems. Englewood Cliffs NJ: Prentice Hall, Inc., 1982.

12. Sutherland, N. B. "Air Force Vehicle Integrated Management System (VIMS) Data Handling Study." Unpublished research report No. MTR-2875, Mitre Corporation, Bedford MA, 1975.

13. Thierauf, Robert J. Decision Support Systems for Effective Planning and Control: A Case Study Approach. Englewood Cliffs NJ: Prentice Hall, Inc., 1982.

14. U.S. Department of the Air Force. Vehicle Integrated Management System User's Manual. AFM 77-310, III. Washington: Government Printing Office, 1981.

15. Vazsonyi, Andrew. "Decision Support Systems, Computer Literacy, and Electronic Models," Interfaces, Vol. 12, No. 1 (February 1982), pp. 74-78.

16. Wagner, G. R. "Decision Support Systems: Computerized Mind Support for Executive Problems," Managerial Planning, September/October 1981, pp. 9-17.

17. ________. "Decision Support Systems: The Real Substance," Interfaces, Vol. 11, No. 2 (April 1981), pp. 77-86.

18. Watkins, Paul R. "Perceived Information Structure: Implications for Decision Support Systems Design," Decision Sciences, Vol. 13, No. 1 (January 1982), pp. 38-59.

B. RELATED SOURCES

Avramovich, Dan, and others. "A Decision Support System for Fleet Management: A Linear Programming Approach," Interfaces, Vol. 12, No. 3 (June 1982), pp. 1-9.

Bennett, John L., ed. Building Decision Support Systems. Reading MA: Addison-Wesley Publishing Company, 1983.

Carlson, Eric D. "An Approach for Designing Decision Support Systems," Data Base, Vol. 10, No. 3 (Winter 1979), pp. 3-15.

Cushing, Barry E. Accounting Information Systems and Business Organizations. 3d ed. Reading MA: Addison-Wesley Publishing Company, 1982.

Davis, Charles K., and James C. Wetherbe. "DSS for Charge-out System Planning, Control in Large-Scale Environments," Data Base, Vol. 11, No. 4 (Summer 1980), pp. 13-20.

De, Prabuddha, and Arun Sen. "Logical Data Base Design in Decision Support Systems," Journal of Systems Management, May 1981, pp. 28-33.

Farwell, David C. "A Model Based Approach to Decision Support Systems Flexibility," Interfaces, Vol. 12, No. 5 (October 1982), pp. 79-86.

Hackett, Lieutenant Stephen B., USAF, and Captain Sam E. Pennartz, USAF. "Decision Support Systems: An Approach to Aircraft Maintenance Scheduling in the Strategic Air Command." Unpublished master's thesis. LSSR 42-82, AFIT/LS, Wright-Patterson AFB OH, September 1982.

Huber, George P. "Cognitive Style as a Basis for MIS and DSS Designs: Much Ado About Nothing?" Management Science, Vol. 29, No. 5 (May 1983), pp. 567-579.

Hussain, Donna, and K. M. Hussain. Information Processing Systems for Management. Cincinnati: Southwestern Publishing Company, 1975.

Reagh, Joseph A. HQ ATC/LGTV. Letters, subject: Vehicle Mileage Estimator, to AFIT/LS, 1982.

Ross, D. T., and others. "Architect's Manual ICAM Definition Method 'IDEF0.'" Unpublished technical report No. CDRL Sequence 21, ICAM Program Office, Wright-Patterson AFB OH, October 1978.

Scott Morton, Michael, and Sidney Huff. "The Impact of Computers on Planning and Decision-Making." In H. T. Smith and T. R. G. Green, eds., Human Interaction with Computers. New York: Academic Press, Inc., 1980.

Sprague, Ralph H., and Hugh J. Watson. "Bit by Bit: Toward Decision Support Systems," California Management Review, XXII, No. 1 (Fall 1979), pp. 60-68.

END

FILMED

12-83

DTIC

9. Work Order

10. Veh Reg Number

11. Nat'l Stock Number

tion.

v = information should be added to the VIMS.

p = parts of the information can be integrated into the VIMS.